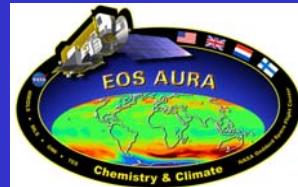


Status OMI Ozone Profile Algorithm

Ben Veihelmann on behalf of:

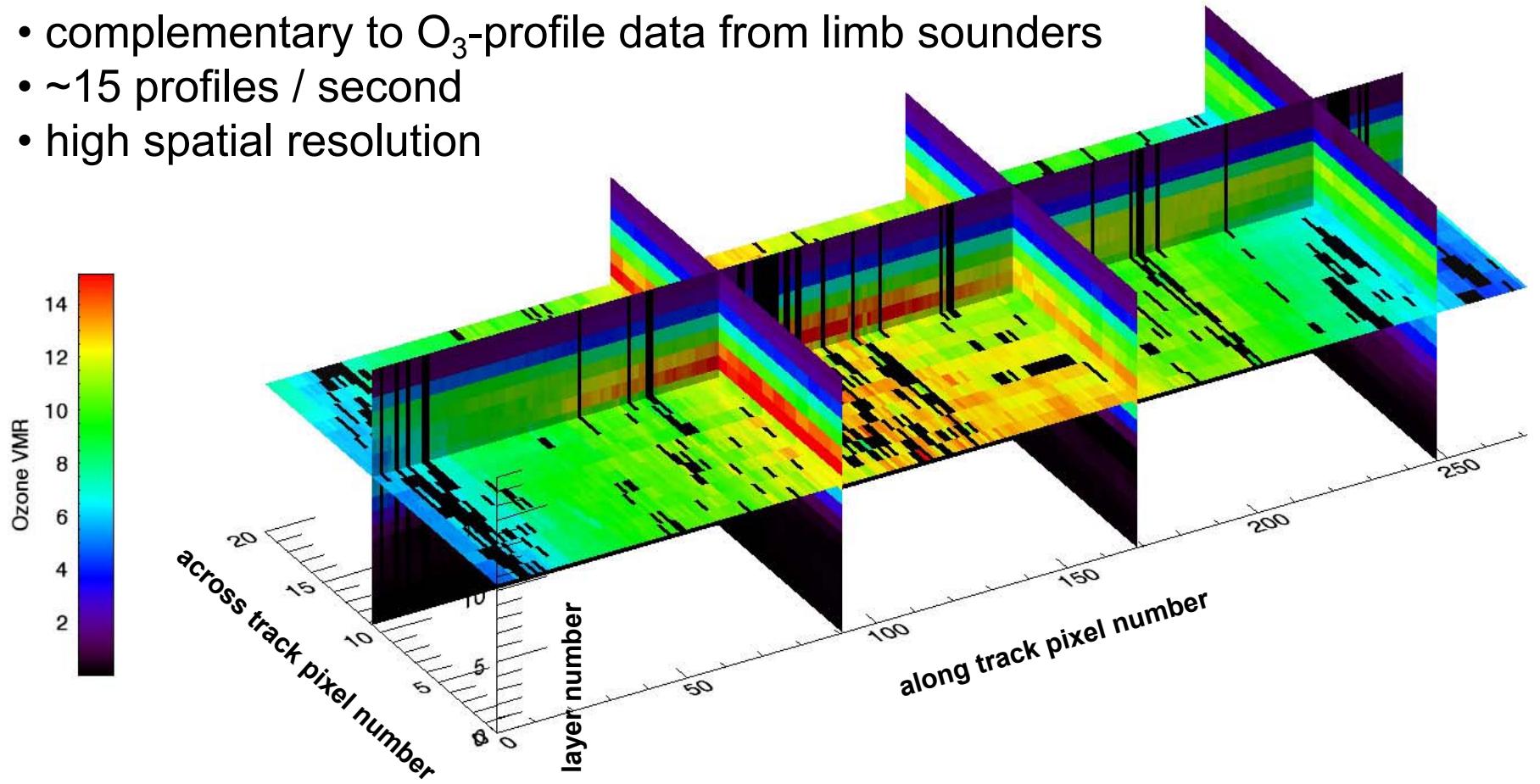
Johan de Haan and Pepijn Veefkind

KNMI, de Bilt, The Netherlands

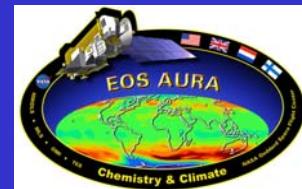


OMI Ozone Profile Product

- complementary to O_3 -profile data from limb sounders
- ~15 profiles / second
- high spatial resolution

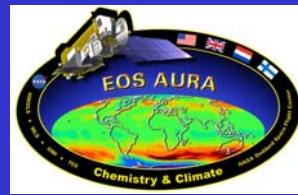


Status Ozone Profile, September 2006, de Haan and Veefkind. Slide 2



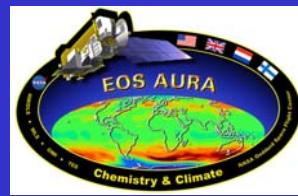
Ozone profile algorithm

- Optimal estimation (Rodgers)
- A-priori: Fortuin & Kelder climatology
- Forward model: on-line radiative transfer (6 stream Lidort-a)
- Non-linear => iterative solution (start with a-priori)
- Use O₂-O₂ cloud product for cloud pressure and (initial) fraction
- Wavelength region: 270 – 330 nm (UV1 & UV2)
- Output: ozone layer column for 18 layers, a-priori, averaging kernel, DFS, error covariance, diagnostics, meta-data



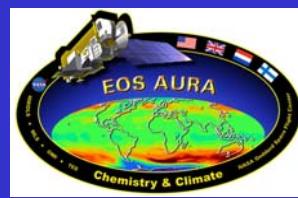
Software

- Software developed by SSF under KNMI guidance, except for the radiative transfer module
- Tests of software using prototype software developed by Roeland van Oss, Olaf Tuinder and Johan de Haan (OPERA, developed for GOME-2 and applied to GOME)
- Software nearly finished, some minor fixes required
- Integration in ODPS in progress
- Converges in about 4-5 iteration steps
- Initially, not all pixels will be processed. Pixels in the cross-track and flight direction can be skipped.

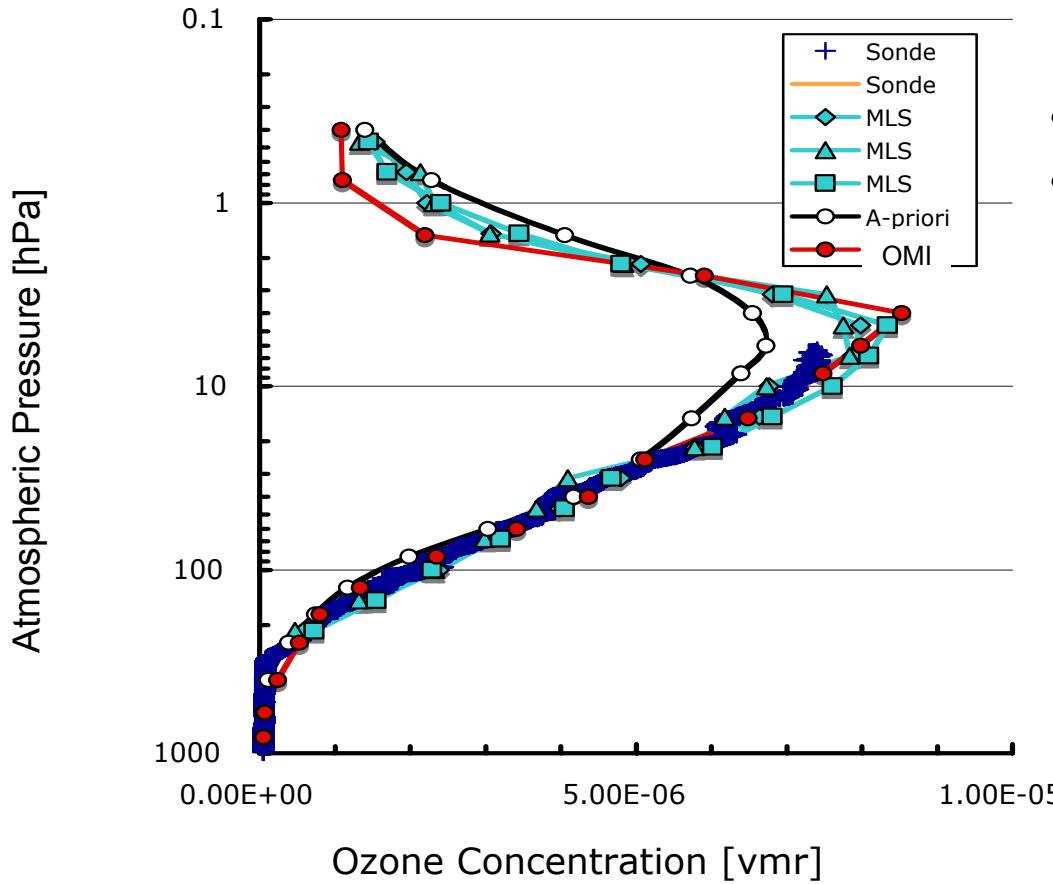


Features

- Optional fit parameters:
surface albedo, cloud fraction, NO₂ column, SO₂ column,
aerosol optical thickness (at 400 nm) [not yet cloud albedo]
- Use Cabannes-Raman scattering to account for Ring effect
- Use absorption cross-section based interpolation
=> less wavelengths for forward calculations (about 100)
- Use polarization correction LUT
- Use Chebyshev expansion of reflectance
=> convolution of radiance with slit function partly stored in
LUT



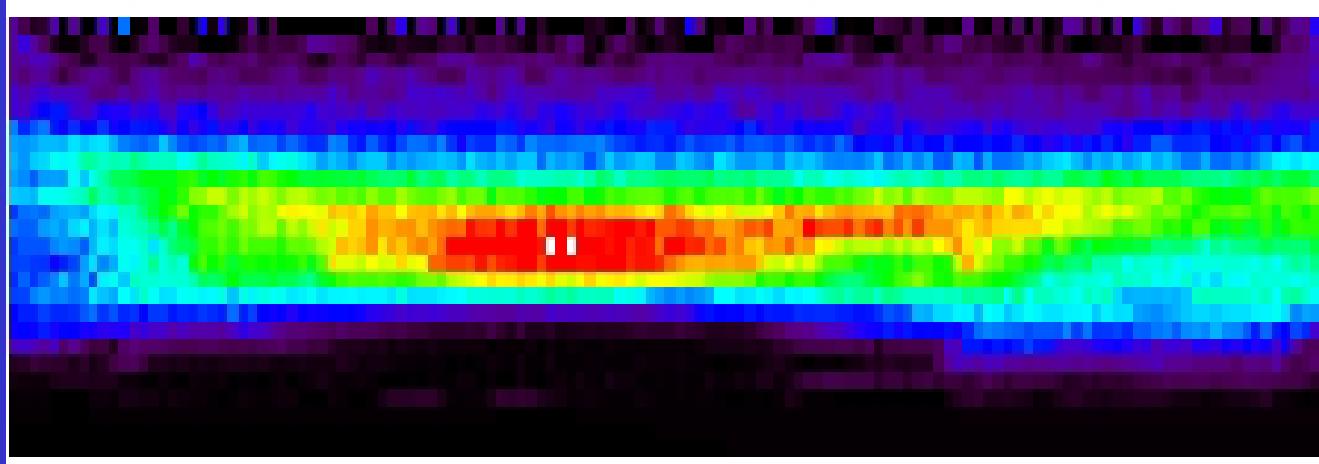
Example: SAUNA validation campaign



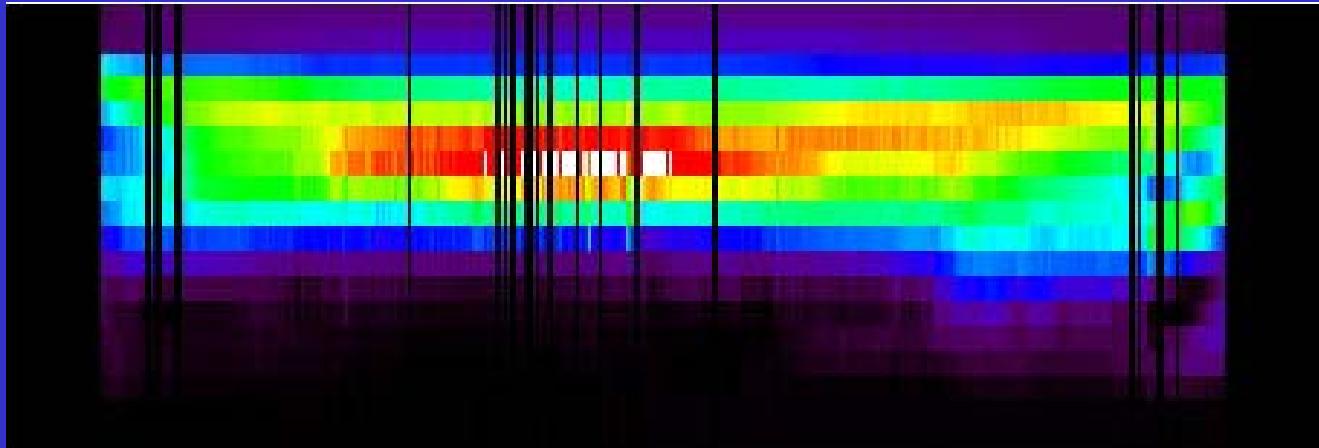
- balloon-borne sonde
- 3 collocated MLS profiles v1.5



Orbit 9235, 10 April 2006

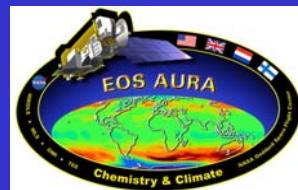


MLS



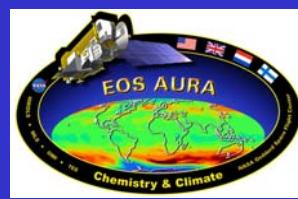
OMI

Status Ozone Profile, September 2006, de Haan and Veefkind. Slide 7



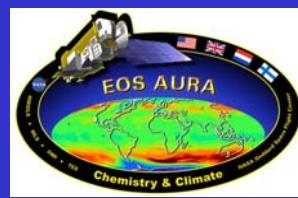
Plans

- Complete inter-comparison with prototype software
write test report
- Prepare for QA, inter-comparison MLS, SBUV, and validation
 - validation: focus on campaigns
- Improve efficiency/accuracy of radiative transfer module
 - Layer Based Orders of Scattering (LABOS) (nearly completed)
 - factor 2.5 - 5 faster than Lidort-a
- Other improvements
 - depends on QA, inter-comparison, and validation
 - e.g. replace F&K climatology, polarization correction LUT
- provisional release: October 2006
- public release: in collection 3



Conclusions

- Based on experience with GOME an improved O₃ profile algorithm has been developed (e.g. account for rot. Raman scattering)
- Complex algorithm => extensive testing with a proven code
- Initial results for OMI data look mostly OK
- Integration in ODPS in progress
- Further improvements depend on QA, inter-comparisons, validation results, and further research:
 - replace radiative transfer module to improve efficiency
 - fit cloud albedo for thick clouds



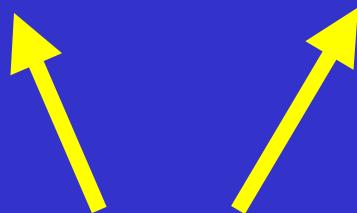
Backup Material

Status Ozone Profile, September 2006, de Haan and Veefkind. Slide 10



Cross-Section Based Wavelength-Interpolation

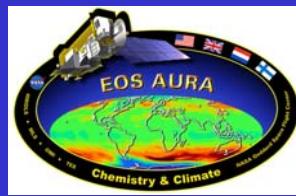
$$R^{fine} = R^{coarse} + \sum_{l=1}^L \frac{dR^{coarse}}{dN_{O3,l}} \cdot N_{O3,l} \cdot \frac{\sigma^{fine} - \sigma^{coarse}}{\sigma^{coarse}}$$



calculate on coarse grid



known on fine grid



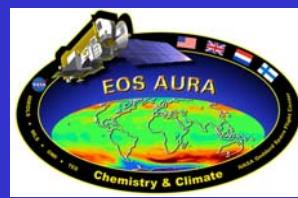
Chebyshev-Expansion
 convolution of sunspectra F_0
 with slitfunction S
 precomputed → LUT

$$R(\lambda) = \sum_{k=1}^K c_k T_k(\lambda)$$

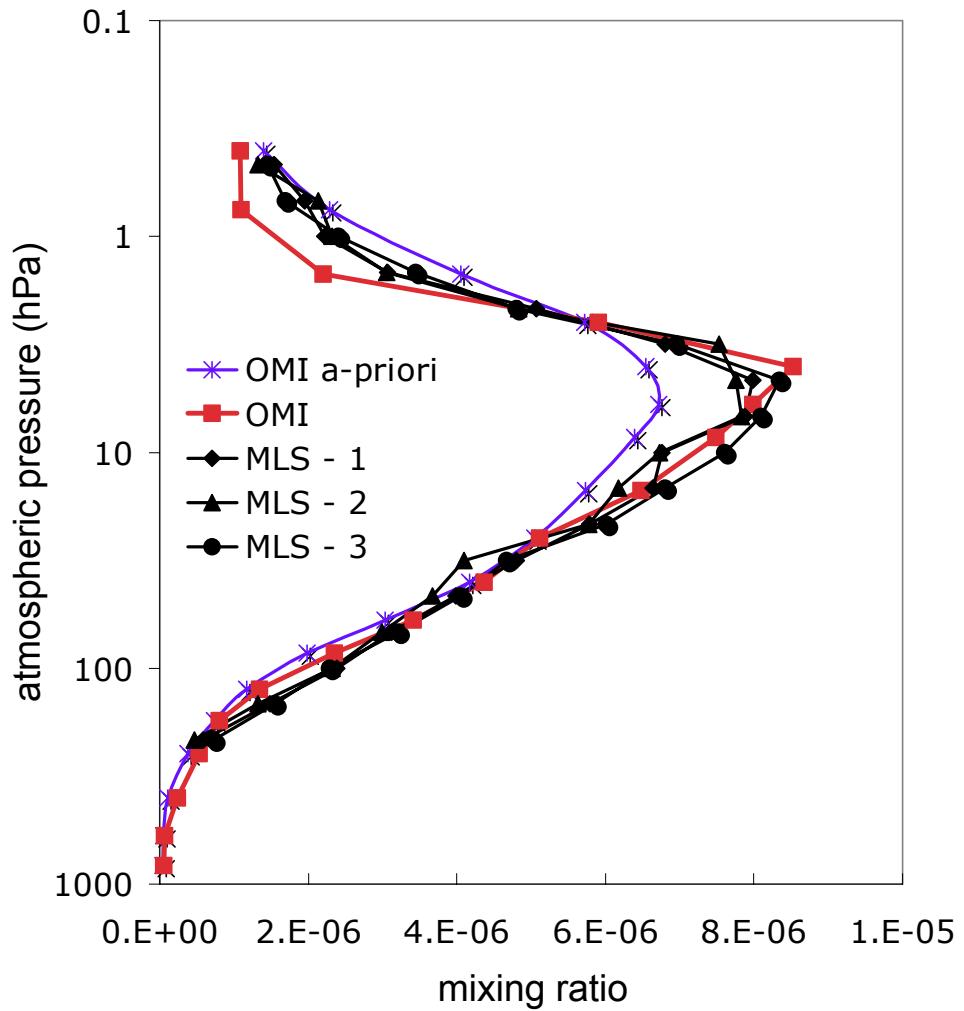
$$c_k = \int R(\lambda') T_k(\lambda') d\lambda'$$

$$d_k = \int S(\lambda, \lambda') F_0(\lambda') T_k(\lambda') d\lambda'$$

$$\bar{R}_i = \frac{\int S(\lambda_i, \lambda') F_0(\lambda') R(\lambda') d\lambda'}{\int S(\lambda_i, \lambda') F_0(\lambda') d\lambda'} = \frac{\sum_k c_k d_k}{\sum_k d_k T_k(\lambda)}$$

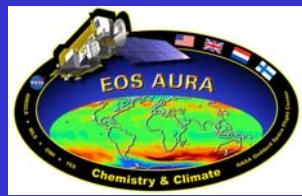


Ozone profile

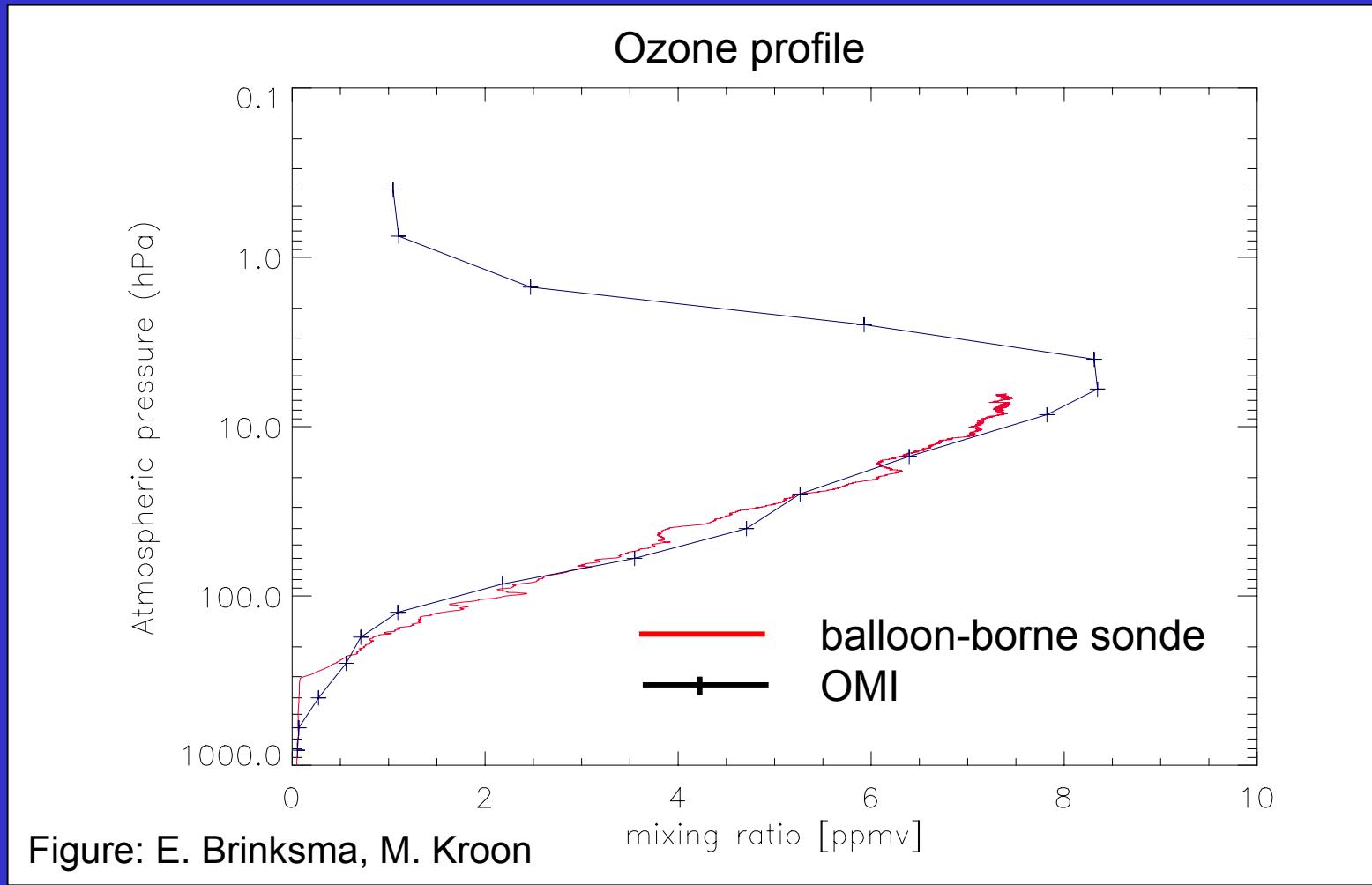


Comparison MLS v1.5
volume mixing ratio

Pixels near
Sodankula

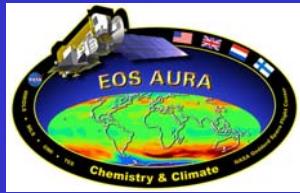


Example: SAUNA validation campaign

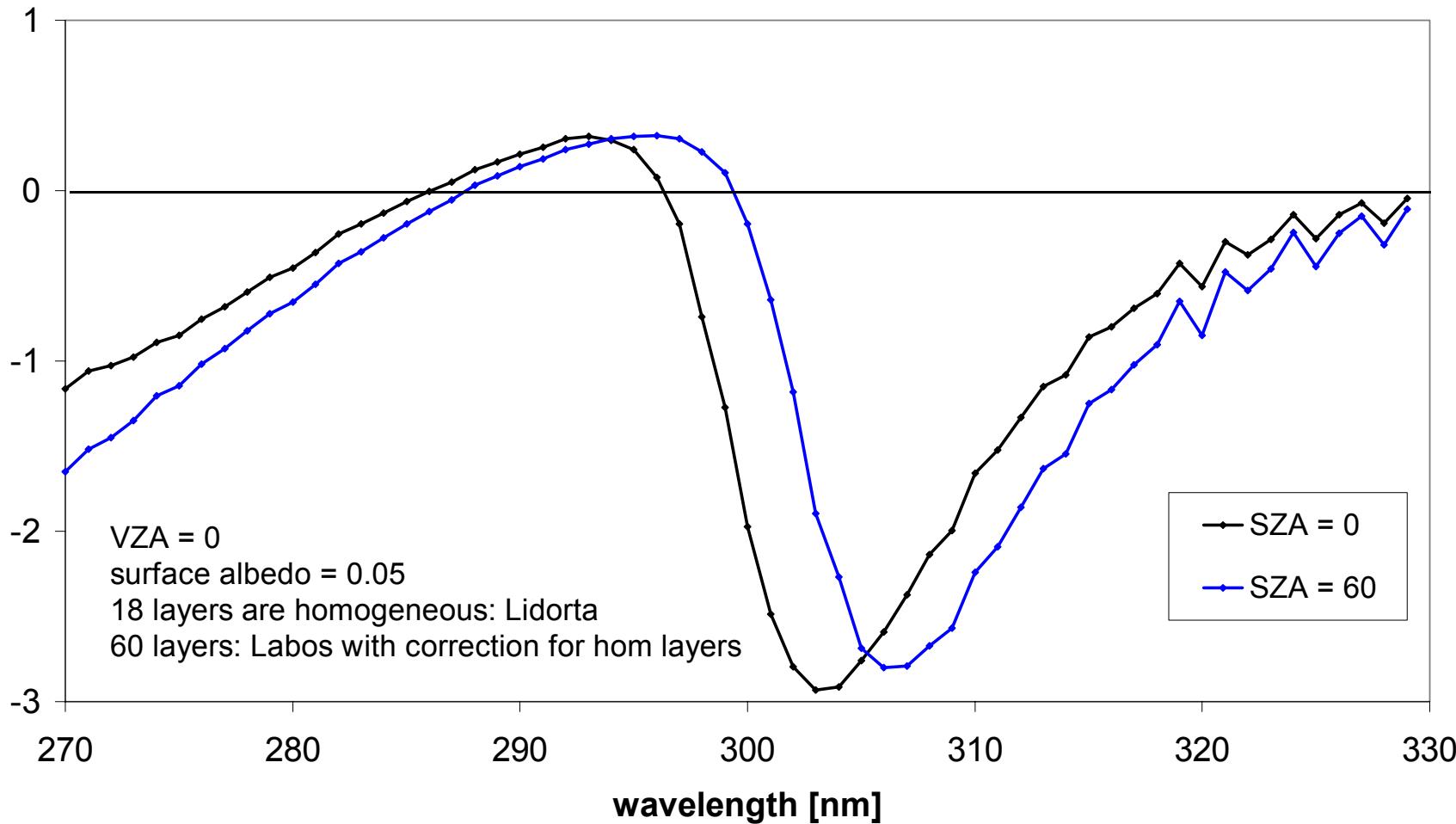


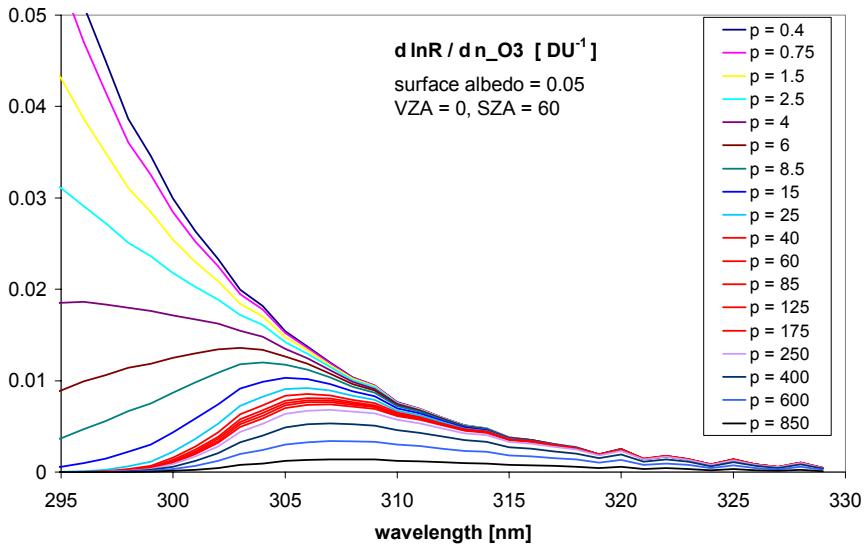
pixel = 6

Status Ozone Profile, 14 September 2006, de Haan and Veefkind. Slide 14



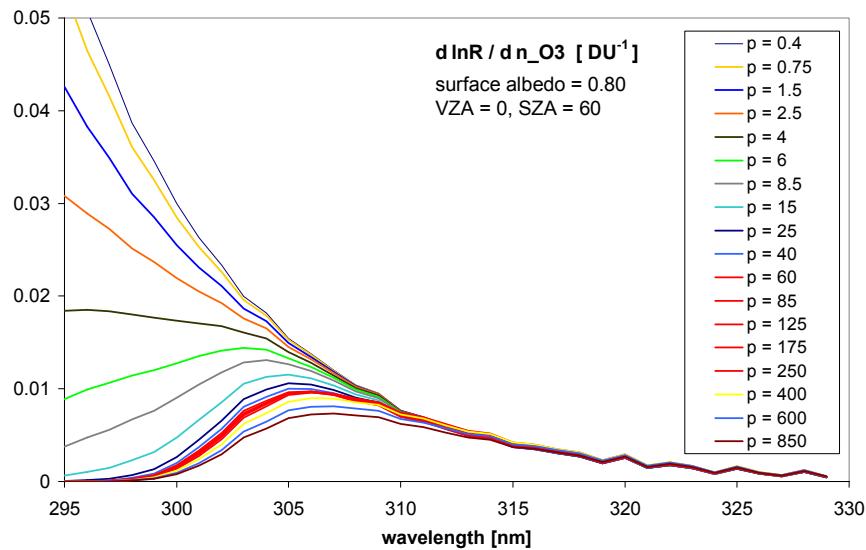
Difference in Radiance Between a 60 an 18 layer model (%)





$A_s = 0.05$

Relative change
in reflectance
if 1 DU ozone
is removed from
an atmospheric layer

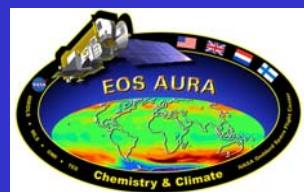
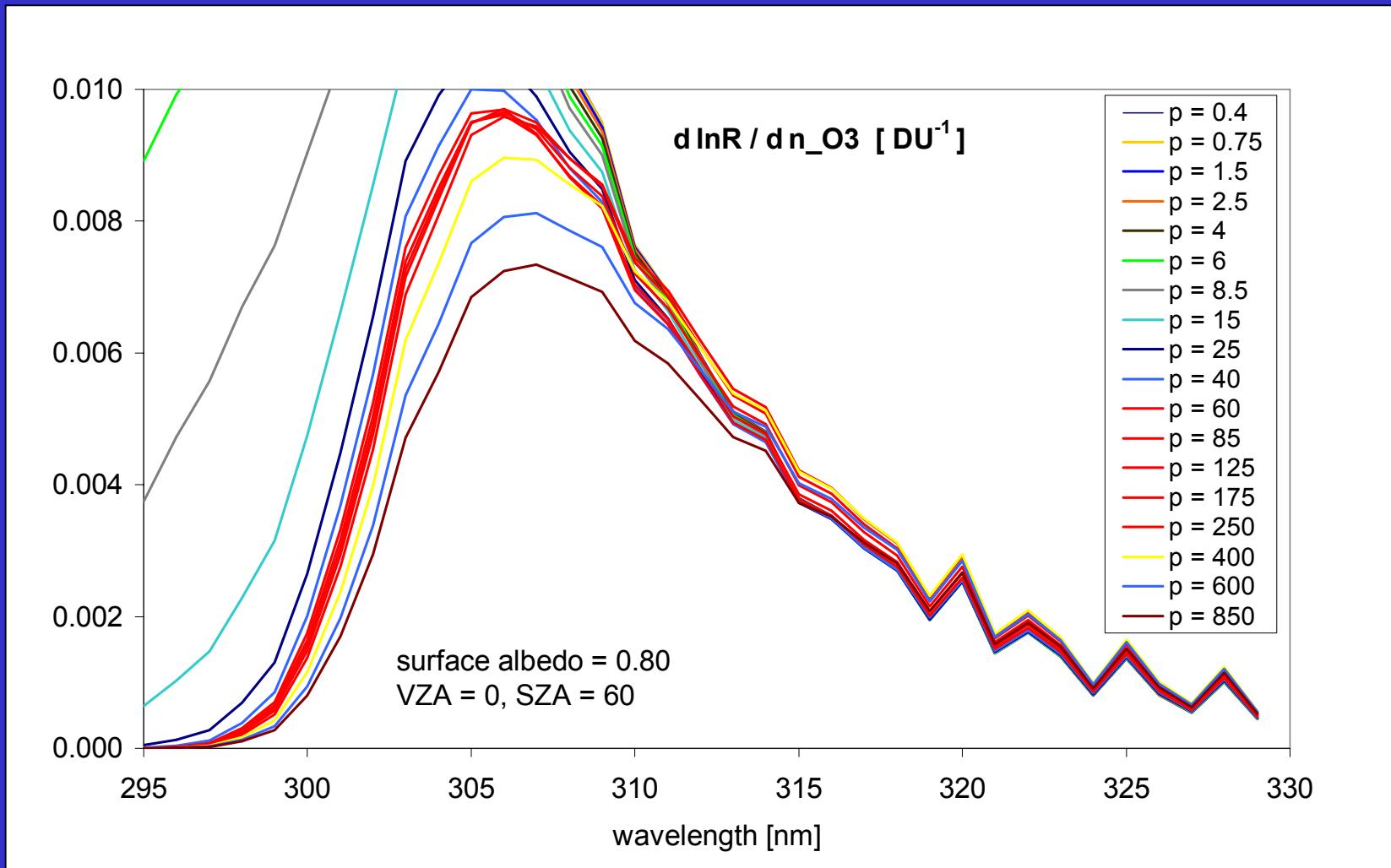


$A_s = 0.80$

p = midlevel pressure

NOTE: isothermal

Zoomed for As = 0.80



Normalized for As = 0.05

